American Potato Journal

Volume XIV **November, 1937** **Number 11**

THE EFFECT OF THE SUN-GREENING OF POTATO SEED TUBERS ON WEIGHT LOSSES IN STORAGE AND ON SUBSEQUENT FIELD PERFORMANCE[1]

K. C. WESTOVER

West Virginia University, Morgantown, West Virginia

The lack of information on the effect of sun-greening potato seedstock before storage when sprouting does not normally occur, together with the possibility that the practice might be of economic value in storage and production, was primarily responsible for the studies here reported, which were in progress during the 1926-1927 and the 1930-1931 seasons.

The White Rural variety was used, and in both instances the seedstocks were removed from certification not more than a year during which time they were frequently and thoroughly rogued to eradicate disease. None of the tubers was disinfected and in so far as possible they were matured under natural conditions in the field. Only well-shaped, unbruised tubers ranging in weight from 115 to 250 grams (4 to 9 ounces) and free from insect and disease injury, were used.

The tubers were greened by placing them in a single layer on a bench in a cool greenhouse where they were exposed to the sun. In order that the greening be uniform over the entire tuber surface, they were turned at frequent intervals. The treatment was considered completed when, from frequent inspections after the tubers had become very dark, no increase in color could be detected. A comparison of the cross-section of a freshly cut tuber with one which had remained covered since the previous inspection was found a satisfactory means of estimating the increase in color intensity. The treatment period varied from 20 to 35 days depending on the season and the time of the season treatment was in progress.

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[1] Published with the approval of the Director, as Scientific Paper No. 182, at the Agricultural Experiment Station.

The tubers used as controls were arranged in the same manner as those which were greened except that they were in a compartment constructed of black paper and black cotton cloth. Provision was made for adequate ventilation, but light was withheld. Attempts to maintain the same temperatures for the control tubers as for those greening were not entirely successful. For short periods of time during the middle of the brighter days the temperature differed as much as 8°C (15°F), whereas at other times during the day seldom did the difference become greater than 3.9°C (7°F). As would be expected a shorter time was required when the greening took place in the early fall months and the fluctuation in temperature was greater during the day.

At the termination of the greening period the tuber samples of both treatments were immediately moved to storage, where they remained until needed for the field trials. Open-mesh sacks of ¾-bushel capacity were used for containers in storage.

To determine losses in weight during treatment and subsequent storage, weight records were taken to ½ gram accuracy on a definite number of tubers of each treatment immediately before and after the greening period and again at the end of the storage period. The percentage weight lost by each tuber for the different periods was derived, and the mean for the losses in each treatment was calculated.

The planting scheme used in the field trials, here termed the "half-tuber hill method", consisted of adjacent duplicate plantings made with the longitudinal halves of the same tubers. These duplicate plantings are here designated as sections A and B. The sets or tuber halves were planted by hand in hills three feet apart in both directions or "checked." Tubers of a third treatment, of no interest here, were included in these plantings. The sequence of the treatments was the same throughout the entire planted area. The rows were twenty-five hills in length and the first and the last hills were planted therefore with a set of the same treatment. This plan resulted in a systematic arrangement of the treatments from left to right as well as from front to rear. The usual precautions were taken to minimize border influences. Care was taken that the planting operations were uniform and level culture was practiced throughout the growing season.

The time of plant emergence and the development of the flower buds were considered as criteria of earliness, since the plants that first break ground, all other things being equal, are generally the highest

producers. The earliness of flower-bud development was taken as an indication of the beginning of tuber formation.

The number of stalks on each plant, the height of plant, and the span of the plant were used as a basis for growth differences. Plant measurements were taken to the nearest half inch. Plant height was considered as the distance from the point at which the plant stalk emerged from the soil to the base of the growing point of the tallest plant stalk. The average of two measurements of the plant width taken at right angles to each other was considered the span of the plant.

The tubers were harvested by hand and the yields of the individual hills were sized in accordance with government requirements for the standard grades on a mechanical grader. A record was taken of the number of No. 1 tubers to the hill, the yield of No. 1 tubers, and the total yields to the hill to 1/10 pound accuracy.

Whenever possible the mean value of the measurements for each factor considered, together with its probable error, has been calculated and the significance of the difference existing between the means of the compared treatments has been determined by the ordinary methods. A difference between means is here considered as significant when it is 3.2 or more times its probable error, which according to Love's table,* corresponds to odds greater than 31 to 1 against so great a difference in either direction due to chance alone.

The 1926-1927 Study

Sample lots of 100 tubers each were selected for the 1926-1927 study. The greening period of 35 days lasted from the 29th of November to the 4th of January and was purposely delayed to avoid extreme temperature fluctuations during the greening process. The temperature for the most part ranged between 4.4° and 10.0°C (40° and 50°F). There was no evidence of sprout development on the tubers of either treatment at the end of the greening period when the tubers were placed in permanent storage where the temperature varied from 3.3°C (38°F) to 7.2°C (45°F) and the relative humidity was seldom less than 70 per cent. On the 3rd of March apical sprout development on the tubers of both treatments had begun, that on the greened tubers being evident only on close inspection. The sprouts on the check tubers were about 3 mm. long. A second weighing was

* Love, H. H. 1936. Table based in five-place probability values from Davenport's table IV. Laboratory Exercises in Statistical Methods of Analysis, Dept. Plant Breeding, Cornell Univ. 24. 1936.

TABLE 1—*Comparison of mean losses in weight from greened and ungreened Rural tubers during greening and storage periods of* 1926-1927 *season*

Treatment	Mean Weight Losses in Per Cent for Periods between							
	Nov. 29 and Jan. 4	No. of Tubers	Jan. 4 and Mar. 3	No. of Tubers	Mar. 3 and Apr. 8	No. of Tubers	Nov. 29 and Apr. 8	No. of Tubers
Greened	4.88 ± 0.08	198*	1.05 ± 0.002	190	4.09 ± 0.08	97	9.78 ± 0.18	97
Ungreened	3.55 ± 0.01	200	1.60 ± 0.002	200	1.20 ± 0.03	100	5.96 ± 0.12	100
Difference	1.33 ± 0.08		0.55 ± 0.003		2.89 ± 0.09		3.82 ± 0.22	
Significance	Significant		Significant		Significant		Significant	

* The use of larger numbers of tubers for parts of the season was made possible because of additional lots of the same seed-stock receiving the same treatments at that time.

made at this time. The last weighing was made on the 8th of April, 95 days after the seedlots were placed in storage, at which time the sprouts on the greened tubers were about 6 mm. long. Those on the check tubers were, on the whole, slightly longer. Sprout development was decidedly apical in both samples, there being no apparent difference in the type of sprout produced.

A comparison of the losses in tuber weight for the season is given in table 1. The losses are here shown to have been greater for the greened tubers except for the mid-period of storage, when the losses from the ungreened tubers were greater.

The 1927 half-tuber hill planting was made on the 3d of May at Kingwood, W. Va., three weeks after the last weighing in storage. This delay in planting was necessitated by bad weather. At planting time the tubers of both treatments had developed short, thick, apical sprouts 6 to 12 mm. in length. There seemed to be no difference in type of sprout.

No plant measurements were taken during the growing season. However, general notes on plant vigor were made on the 3d of June, a month after the planting was established, at which time plant stand and development were the same in both treatments. Later inspections made on the 23d of June and in July and August showed no differences in plant growth.

TABLE 2—*Comparison of yields from half-tuber hill planting* 1927

Treatment and Comparison	No. of Hills	Mean Yield of No. 1 Tubers per Hill in Lbs.	Mean No. of No. 1 Tubers per Hill	Mean Total Yield per Hill in Lbs.
		Section A		
Greened	99	2.41 ± 0.06	5.55 ± 0.13	2.84 ± 0.06
Ungreened	89	1.90 ± 0.05	5.07 ± 0.10	2.13 ± 0.05
Difference		0.51 ± 0.08	0.48 ± 0.16	0.71 ± 0.08
Significance		Significant	None	Significant
		Section B		
Greened	99	2.44 ± 0.06	5.41 ± 0.13	2.62 ± 0.06
Ungreened	90	2.42 ± 0.08	6.16 ± 0.14	2.66 ± 0.06
Difference		0.02 ± 0.10	0.75 ± 0.19	0.04 ± 0.09
Significance		None	Significant	None

The plants were harvested on the 5th of October. The yield data from this trial are compared in table 2. It is evident that the

yields from the two sections of the planting did not agree in a number of respects. The greened tubers yielded more than the ungreened in No. 1 tubers in both sections. However, the difference in section B was significantly greater in the check tubers, whereas in section A the difference, although small and of no significance, favored the greened tubers. The total yield for each plant from the greened seed tubers was significantly greater in section A, although in section B there was no difference. In general, this table shows that the two sections of the planting gave conflicting results and there is doubt if the differences obtained are of much importance.

Test Conducted in 1930-1931

The 1930-1931 study was conducted in the same manner as above except that there were 75 tubers in each sample, and instead of the samples being held under good storage conditions after the greening period they were subjected to conditions intended as nearly as possible to duplicate those prevalent in ordinary farm storage. Table 3 describes the storage conditions and gives the number of days the tuber samples remained in each. This change in procedure was made on the assumption that poor storage conditions might result in greater differences in storage behavior.

Table 3—*Description of storage conditions* 1930-1931 *season*

Dates and Number of Days in Storage	Kind of Storage	Temperature Fluctuations	General Description of Conditions
Dec. 3 to Mar. 11 (96 days)	Side hill or cave	—0.6° to 8.3°C (31° to 47°F)	No adequate means of ventilation—some moisture seepage on the sides—earth floor—humidity high
Mar. 11 to Mar. 31 (20 days)	Above ground "air-cooled"	16.7° to 21.7°C (62° to 71°F)	Air shaft ventilation—fluctuation of temperature for short periods of time—concrete floor—humidity low
Mar. 31 to May 5 (7 days)	Moderately cool cellar	10.0° to 16.7°C (50° to 62F°)	No means of ventilation other than door—humidity medium to low

The greening required 21 days, starting on November 13 and ending on December 3 when a second weighing was made. The prevailing temperature was about 21.1°C (70°F) during the day and

about 15.5°C (60°F) at night. Sprout development on the greened tubers was discernible only on careful inspection, whereas some of the check tubers had apical sprouts 3 mm. in length. On the 5th of May at planting time, the tubers of both treatments had apical sprouts varying from 4 to 8 cm. in length, the check tubers having somewhat the longer apical sprouts. The tubers of both samples were somewhat wilted but not noticeably withered. The comparisons of losses in tuber weight for the greening and subsequent storage periods are given in table 4 and show, in this case, that the ungreened tubers lost more weight during both periods, but the differences are small and of no significance.

TABLE 4—*Comparison of mean losses in weight from greened and ungreened Rural tubers during greening and storage periods of* 1930-1931 *season*

Treatment and Comparison	Number of Tubers	Mean Weight Losses for Periods between		
		Nov. 13, 1930 and Dec. 3, 1930	Dec. 3, 1930 and May 5, 1931	Nov. 13, 1930 and May 5, 1931
Greened	75	1.25 ± 0.05	8.96 ± 0.21	10.11 ± 0.22
Ungreened	75	1.41 ± 0.08	9.61 ± 0.20	10.73 ± 0.21
Difference		0.14 ± 0.09	0.65 ± 0.29	0.62 ± 0.30
Significance		None	None	None

The 1931 half-tuber hill trial was planted on the 5th of May at Reedsville, W. Va., immediately after the last weighing in storage. Plant height measurements, taken as a criterion of early vigor, were made on the 10th of June. A comparison of the height of the plants from the tubers of the two treatments is given in table 5. The differences in plant height from both sections of the planting are very small and of no significance.

TABLE 5—*Comparisons of means of plant growth and yield determinations taken on 1931 field trials*

Part I—Comparison of Mean Plant Height—June 10

Treatment	No. of Plants	Section A	No. of Plants	Section B
		Mean Plant Height in Inches		
Greened	74	6.07 ± 0.16	74	6.47 ± 0.17
Ungreened	75	6.37 ± 0.16	75	6.73 ± 0.14
Difference		0.30 ± 0.23		0.26 ± 0.22
Significance		None		None
		Part II—Comparison of Mean Number of Stalks per Plant—July 7		
		Mean Number of Stalks per Plant		
Greened	74	3.61 ± 0.11	74	3.57 ± 0.10
Ungreened	75	3.45 ± 0.10	75	3.61 ± 0.14
Difference		0.16 ± 0.15		0.04 ± 0.17
Significance		None		None
		Part III—Comparison of Mean Plant Span—July 7		
		Mean Plant Span in Inches		
Greened	74	23.34 ± 0.41	74	22.80 ± 0.46
Ungreened	75	23.98 ± 0.42	75	22.88 ± 0.41
Difference		0.64 ± 0.59		0.08 ± 0.62
Significance		None		None
		Part IV—Comparison of Mean Plant Height—July 7		
		Mean Plant Height in Inches		
Greened	74	15.78 ± 0.24	74	15.02 ± 0.28
Ungreened	75	16.38 ± 0.29	75	14.82 ± 0.24
Difference		0.60 ± 0.38		0.20 ± 0.37
Significance		None		None
		Part V—Comparison of Yields		
		Mean Yield of No. 1's per Hill in Pounds		
Greened	73	0.88 ± 0.03	69	0.83 ± 0.03
Ungreened	71	1.01 ± 0.04	69	0.75 ± 0.03
Difference		0.13 ± 0.05		0.08 ± 0.04
Significance		None		None
		Mean Number of No. 1's per Hill		
Greened	73	3.58 ± 0.13	69	3.07 ± 0.12
Ungreened	71	3.76 ± 0.13	69	3.52 ± 0.15
Difference		0.18 ± 0.18		0.45 ± 0.19
Significance		None		None
		Mean Total Yield per Hill in Pounds		
Greened	74	1.20 ± 0.04	74	1.09 ± 0.03
Ungreened	75	1.24 ± 0.04	75	1.02 ± 0.03
Difference		0.04 ± 0.06		0.07 ± 0.04
Significance		None		None
		Mean Number of Tubers per Hill		
Greened	74	9.84 ± 0.32	74	8.82 ± 0.23
Ungreened	75	8.54 ± 0.23	75	8.54 ± 0.23
Difference		1.30 ± 0.39		0.28 ± 0.33
Significance		Significant		None

On the 22d of June observations were made of the degree of blossom development to determine differences in plant maturity. These data are summarized in table 6, and it is evident that little difference in this respect existed.

TABLE 6—*Summary of field observations in plant maturity taken June 22, 1931*

Treatment	Determination	Section	
		A	B
Greened	Buds showing, but no bloom	67	68
	Full blossom	4	5
	No buds	3	1
	Missing hills	1	1
Ungreened	Buds showing, but no bloom	72	70
	Full blossom	1	4
	No buds	2	1
	Missing hills	0	0

By the 7th of July the plants had passed through the blossoming stage, and were erect and rapidly nearing that period of development at which they could be expected to fall. Assuming that the greening treatment might influence the plant later in the season a second set of growth measurements was taken at this time. In addition to plant height these measurements included the number of stalks and the span or diameter of the plant. The comparisons of these measurements appear in table 5. Again there is little evidence that real differences for these measurements existed, since none of the differences is large or significant. Only in plant span are the two sections of the planting in agreement. Observations made at various times during the latter part of the season failed to show differences between plants in growth or length of life that would indicate the effect of treatment.

On the 13th of October the tubers were harvested and similar data taken as in the 1927 study, except that a record of the total number of tubers to each plant was included. The comparisons of the yields from this planting appear in table 5 and the differences are, with one exception, small and insignificant, this exception being the greater number of tubers to the hill from the greened seed tubers in section A. Section B is in agreement in this respect, but the difference has no significance.

The results of these field trials seem to offer little consistent evi-

dence that the greening of the tubers influenced earliness of maturity, plant growth during the season, the number of tubers, or the yield for each plant.

The effect of the greening treatment on the loss of tuber weight during the greening and storage periods differed for the two seasons. This can be partially accounted for by the fact that the general conditions under which the seedstocks were greened were quite different. The explanation for these different results can undoubtedly be attributed to some extent at least, to the temperatures prevailing during the greening period of the 1926-1927 season, which were too low for the rapid suberization of the tuber skins. That this is only a partial explanation is evidenced by the fact that, except for the mid-storage period, the greened tubers continued to lose more weight throughout the entire storage period than did the ungreened tubers, even though the latter were held under somewhat less favorable conditions for suberization during the greening period. This suggests that the greening in some manner influenced the loss of tuber weight, possibly by its effect on the physiological activities in the tuber or perhaps it had to do with the permeability of the tuber skin or possibly both.

The greening in 1930 was accomplished earlier in the season, the temperatures were higher and a shorter period of time was required. Due probably to the favorable conditions for rapid suberization no differences in loss of tuber weight were found for either the greening or subsequent storage period. This strongly suggests that the suberization of the tuber skins may have been an important factor in respect to the part that greening played in losses in weight.

These studies, considered as a whole, indicate that greening carried on under conditions conducive to rapid suberization has little or no effect on the loss of weight of the tuber. However, under conditions unfavorable for suberization it appears in some manner to increase the loss in weight of the tuber during most of the storage period.

The analysis of the data taken to determine differences in plant development and yields gives little indication that the greening exerted any influence, regardless of the different conditions under which it was accomplished or of the quality of the storage which succeeded the treatment. There is no evidence from these studies that the sun-greening of potato seed tubers before storage is of practical value.

WIREWORM CONTROL FOR MAINE POTATO GROWERS

JOHN H. HAWKINS

Maine Agricultural Experiment Station, Orono, Maine

LOSSES CAUSED BY WIREWORMS

There was a loss of approximately 2,000,000 barrels of potatoes in Maine during the season of 1930-1931 because of injuries caused to the tubers by wireworms.* This represented a loss of more than $3,000,000 to potato growers of the state. With the exception of certain areas in Aroostook County, all the farming sections of Maine are subject to wireworm infestation. Although the amount of damage done varies from one year to another, considering the state as a whole, serious losses are caused annually by these pests.

LIFE HISTORY IN RELATION TO WIREWORM CONTROL

The several species of wireworms found in Maine differ with regard to the amount and kind of injury which they inflict. Variations in life history and the habits of the species cause them to react differently to various kinds of crops and to the kind of farming practices employed. For this reason a knowledge of the life history is essential as a basis for the control of wireworms, and a lack of such knowledge is sometimes the underlying reason for the failure to obtain satisfactory control. Fortunately, the life history of the wheat wireworm, *Agriotes mancus* Say, the most destructive species affecting potatoes in Maine, is fairly well known and the practices discussed in this paper apply especially to this species.

EFFECT OF CULTIVATION ON WIREWORMS

Cultivation is effective in ridding the soil of wireworms by making conditions unfavorable for mating and egg laying as well as maintaining conditions adverse to the eggs and very young larvae. Older larvae are not greatly reduced in numbers directly by cultivation, although an occasional one may be crushed by contact with farm machinery. By far the greater portion of the larvae live in the cultivated soil until they transform to pupae, then they emerge as adults and leave

* Estimate based on reports furnished by C. M. White, State Department of Agriculture, Augusta, Maine.

the cultivated fields for mating and egg laying elsewhere. The pupal stage of wireworms is not seriously affected by the cultivation of the soil, for the greater number of wireworms do not pupate until cultivation has ceased for the season, and fall plowing cannot usually be done early enough to disturb the pupae in their earthen cells. The plowing of hayland in early August is of some value, for a certain number of pupae and newly-formed adults are broken from the pupal cells and exposed to the weather and predaceous enemies.

Once the wireworms are controlled by cultivation, the soil will remain safe for potatoes until conditions are again favorable for building up the depleted wireworm population. Long-standing hay crops provide favorable conditions for increasing the wireworm population, for the soil is undisturbed by cultivation for several years during which time new generations of wireworms are able to develop unmolested.

Potatoes are among the crops most susceptible to wireworm injury (1). Cultivated crops resistant to wireworm attack are ideal for growth in infested soil and may be grown for such time as is necessary to reduce the wireworm population to a point consistent with safety to potatoes (2). The time required to do this varies from one to four years, depending upon the extent of the initial wireworm population, the kind of wireworms present, and the thoroughness with which the soil is cultivated.

The Role of Soil Utilization in Wireworm Control

Utilization of soil in which the wireworm population does not exceed the limits of safety to potatoes avoids unnecessary risk of injury to the seed, the growing plants, or the mature tubers. Data acquired over a period of ten years, indicate that where more than three or four wireworms are present to the square yard within a given area, such soil should be utilized for the growth of a crop less susceptible to wireworm injury until the wireworm population is reduced to a point consistent with safety to potatoes. It is a good practice to divide crop land according to soil types and wireworm population and to plant wireworm-resistant crops in soil unsafe for potatoes, especially where grain or hay is to be grown in the rotation. Fortunately, in Maine the best potato soil of the light loam type is not ordinarily infested by wireworm populations so large as to be a menace to potato production. Maximum utilization of the best potato soil may be obtained by growing potatoes as often as practicable in the rotation and a green manure crop need be grown only as often as necessary to maintain soil fertility.

The Use of Green Manure Crops in Wireworm Control

An annual, such as crimson clover, buckwheat, or small grain, when used as a green manure crop in the potato rotation has a distinct advantage not only from the standpoint of occupying less time in the rotation but also from the standpoint of wireworm control. The use of a green manure crop of the annual variety enables the potato grower to keep the soil in cultivation a large proportion of the time, thereby preventing the building up of large wireworm populations. Planting after the 15th of June affords an opportunity for the cultivation of the soil during a large part of the mating season of the beetles and at the time when the eggs are being deposited.

Common red clover is less objectionable, from the standpoint of wireworm development, than are the longer-standing meadow grasses. Not only is clover practically immune from wireworm attack, but it survives for approximately two years so that at the worst there could be time for not more than two new generations of wireworms before the soil would again be plowed. When common red clover is seeded with oats, however, conditions are favorable for wireworms from the standpoint of a habitat undisturbed and a bountiful supply of young oat plants, a favorite food of one of the most destructive species of wireworms. Under such conditions the soil is not cultivated during June of the first year's seeding, and weeds and grass may grow voluntarily so that the second year, during which the clover stands as a hay crop, plenty of food is available for the wireworms. Crimson clover survives but one year and in some localities may be seeded as late as the 15th of June. This late planting permits cultivation during the first half of June, a critical time for the arising generations of wireworms. The chief objection to Crimson clover is that weeds may grow freely among the clover or that the clover does not grow sufficiently to provide ample vegetation for green manure. Buckwheat meets all the conditions required for a good green manure crop for wireworm-infested soil except that it may not provide materials of the kind or quantity sometimes considered best for improving the soil fertility. It may be planted late enough so that the soil can be cultivated during June. Likewise late-planted oats may be safely used as a green manure crop in the potato rotation where the soil is subject to wireworm infestation. Winter rye has also been useful where it has been tried. The advantage in its use is that it may be planted after the removal of the regular crop and that it can be plowed under early in the spring before the planting time of the next crop. Rye has not been used much by potato growers

in Maine, because it is impracticable to establish rye in the fall unless very early potatoes are raised. Such data as we have obtained on the use of winter rye in crop rotations for wireworm control have indicated that it is satisfactory in restoring the humus content of the soil and at the same time does not provide conditions favorable for wireworm abundance.

The Effect of Early Digging on Wireworm Injury to Potatoes

Potatoes harvested from wireworm-infested soil early in the season are invariably less severely injured than are those harvested later. The amount of damage done to tubers left in the soil until late in the fall varies for a given wireworm population. The weather, the kind of wireworms present, the type of soil, and the kind and amount of food other than potatoes which is available to the wireworms are important factors in determining the amount, and to some extent the type of injury, that shall be done.

The following table illustrates the importance of early harvesting of potatoes from wireworm-infested soil:

Date of Harvesting	Approximate No. Wireworms to the Square Yard	Percentage of Tubers Injured	Injuries per 100 Tubers
Sept. 12-15	44	27.51	129
Oct. 14-16	44	42.27	340

The data upon which the above table is based were obtained from experimental plots maintained at Monmouth, Maine. The soil in this area is of medium to heavy loam, containing a small amount of sand. Drainage is fairly good, and, in general, wireworm injury is somewhat lighter than in many heavier types of soil used for potato culture. Observations and data obtained over a period of years agree in substance with the information contained in the foregoing table. Early planting and the use of early-maturing varieties of potatoes make early harvesting possible, and, in this manner prevent excessive wireworm injury to the crop.

1. Hawkins, John H. 1936. Relation of soil utilization to wireworm injury. Jour. Econ. Ent. 29(4):730.
2. Hawkins, John H. 1936. The bionomics and control of wireworms in Maine. Bul. 381:93-97.

INTERRELATION OF SPACING OF SEED PIECE AND RATE OF APPLICATION OF FERTILIZER IN THE PRODUCTION OF POTATOES IN ALABAMA

L. M. WARE

Alabama Agricultural Experiment Station, Auburn, Alabama

In many sections of the South an acre of land may be bought for what it may cost to plant and handle one acre of potatoes. The cost of materials involved in planting one acre even at normal prices for seed can be made to vary within reasonable limits from the relatively low cost of $24.00 to the high cost of $66.00 to the acre by varying the size of seed piece, the spacing of seed pieces, and the amount of fertilizer used. Since the cost of producing potatoes is so high and since there is so wide a range in the possible cost of seed and fertilizers, it is of very great importance that the particular combination or combinations be known which offer the best returns for the money invested. Many experiments (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11) have been conducted to determine the influence of size of seed piece and spacing of seed pieces on the yield and grade of potatoes. However, these experiments have been conducted with few exceptions (6, 10) at only one rate of application of fertilizer. It is quite apparent that different results might have been obtained in any of these experiments had a different rate of application of fertilizer been used, and that different relative increases in yield for increases in size of seed or for different spacings might have been obtained had several different rates of application of fertilizer been used. A more comprehensive study of the interrelation of size of seed piece, spacing of seed pieces, and rate of application of fertilizer is needed.

In 1931 the Alabama Experiment Station began a series of related experiments in the State's commercial potato-producing section, for the purpose of studying economics of potato production as affected by the interrelation of three factors: rate of application of fertilizer, size of seed piece, and spacing of seed pieces.Three distinct but related experiments were conducted. Each of these experiments in successive years was rotated over three separate experimental areas. In each experimental area there were 51 plots of 1/60 acre each, disposed in three tiers of 17 plots. Thirteen treatments in triplicates and 15 check plots were used to the area. The experiments were continued for a period of five years. Since the experiments were rotated over three areas, each treatment, during the course of the experiment, has involved

nine different plots. This rotation was intended to reduce the error incident to individual plot variations.

In the experiment which is reported herein a study has been made of the interrelation of spacing of seed pieces and rates of application of fertilizer to yields, costs, and value of potatoes. Three rates of application of fertilizer, consisting of 1000, 1500, and 2000 pounds to the acre, were used. These rates correspond approximately to low, medium, and high rates of application of fertilizer as used in the commercial potato section of Alabama. At each rate, 1-ounce pieces were used. The spacings were 20, 16, 12, and 8 inches.

In table 1 are given the No. 1 potatoes, the cost of materials for one acre, the cost of materials for each bushel, and the normal value for each acre above the cost of materials. As would be expected, each more intensive combination, in general, gave increased yield; however, the amount of the increase with closer spacings varied, depending upon the amount of fertilizer applied. Similarly the amount of the increase from different rates of application of fertilizer varied at different spacings. With an application of 1000 pounds of fertilizer to the acre, reducing the interval between pieces from 20 to 16 inches gave an increase in yield of 14 bushels for only 2.27 additional bushels of seed By still further reducing the interval beteween pieces from 16 to 12 inches only 10 bushels increase in yield was obtained for 3.78 additional bushels of seed, whereas reducing the interval between pieces from 12 to 8 inches actually resulted in a reduction in yield. The increase in yield of the 12-inch spacing over the 16-inch spacing gave only a 34.34 increase in the value of the potatoes above the cost of materials on one acre.

With an application of 1500 pounds of fertilizer to the acre, increases in yield for closer spacings continued through the 12-inch spacing; and although there was no increase, there was no decrease in yield as the spacing was narrowed from 12 to 8 inches. With an application of 2000 pounds of fertilizer to the acre, increases in yield continued through the 8-inch spacing, the 8-inch spacing producing 11 bushels more to each acre than the 12-inch spacing. It appears rather definite that the correct spacing is closely related to the amount of fertilizer used. Where 1000 pounds of fertilizer were used to the acre, yields increased through the 12-inch spacing, although economically the 16-inch spacing seems to be the closest spacing justified. Where 1500 pounds of fertilizer were used to the acre, 12-inch spacing was justified. Where 2000 pounds of fertilizer were used to the acre, 12-

inch spacing was the economic limit although the increase in yield of the 8-inch over the 12-inch spacing nearly covered the additional cost.

At each of the four spacings, each increase in the rate of application of fertilizer resulted not only in an increase in yield but also in an increase in the value of the crop after the cost of the extra fertilizer was deducted. This increase in the value of the crop was obtained at all combinations of prices paid for seed or received for potatoes. It is also of special interest to note that high rates of fertilization gave a relatively greater increase in yield at close spacings than at wide spacings. An application of 2000 pounds of fertilizer to the acre produced 10 bushels more to the acre than 1500 pounds at the 20-inch spacing; 21 at the 16-inch spacing; 25 at the 12-inch spacing; and 36 at the 8-inch spacing. An equal increase in fertilizer therefore gave a greater increase in yield with each closer spacing. This emphasizes the importance of an adequate amount of fertilizer with close spacing and the economic soundness of the practice of close spacing with large amounts of fertilizer. An application of 2000 pounds of fertilizer to the acre produced 73 bushels more to the acre than did an application of 1000 pounds, at the 8-inch spacing, but only 31 additional bushels at the 20-inch spacing. At normal prices for seed and for market potatoes this difference at the 20-inch spacing had a value above the added cost of materials of only $16.00 to the acre; at the 8-inch spacing the difference in value was $58.00. It is quite apparent that heavy rates of application of fertilizer are necessary with close spacing; it is also apparent that full benefit from large amounts of fertilizer cannot be obtained at wide spacings.

An examination of the data with reference to the cost of material for each bushel of potatoes produced shows that the cost of producing a bushel of potatoes does not always suggest the most desirable combination. It is not the low cost for a bushel but the high net returns from an acre which in the final analysis determines the most desirable combination. It may be noted that the most cheaply produced potatoes were grown from the least intensive combinations and from the combinations offering least returns to the acre after the cost of materials had been paid. It may also be noted that in four instances the cost of producing a bushel of potatoes was excessively high. In each instance there seems to be a specific reason for the high cost per unit at normal prices for seed. The cost of materials for a bushel of potatoes was 38.28 cents, with an 8-inch spacing and 1000 pounds of fertilizer to the acre. This high cost was most likely because of an insufficient supply of fertilizer for so close a spacing. Similarly with 1500 pounds of fertilizer to the

acre at this same spacing, but to a less extent, it appears that an insufficient amount of fertilizer was present to enable maximum returns from the seed used on the land since an increase of 500 pounds of fertilizer to the acre increased the yield 36 bushels to the acre. At the 20-inch spacing with 2000 pounds to the acre the cost of materials for each bushel of potatoes was 31.14 cents. It would seem that this high cost might be attributed to an insufficient number of plants on the ground to make full use of the large amount of fertilizer applied. At the 8-inch spacing, with 2000 pounds of fertilizer, it is altogether probable that the maximum producing capacity of the land under the seasonal conditions which have obtained during the years of the experiment has been approached. This has resulted in reduced returns from the fertilizer and seed used and has given a high production cost for each bushel.

It seems that a grower often has the choice of investing either in more fertilizer or more seed to obtain about the same increases in yields and returns, although this is not always true. It may be seen that 15.11 bushels of seed (12-inch spacing) and 1000 pounds of fertilizer would cost $37.66 or that 9.06 bushels of seed (20-inch spacing) and 1500 pounds of fertilizer would cost $36.10 at normal prices for seed (table 1). The first combination produced 133 bushels on an acre and had, at normal prices for potatoes, a value above the cost of materials of $95.34 to the acre; the second combination produced 130 bushels on an acre and had a value above the cost of materials of $93.90. Similarly the costs, yields, and returns were about the same where 1500 pounds of fertilizer per acre and 15.11 bushels of seed (12-inch spacing) were used and where 2000 pounds of fertilizer to the acre and 11.33 bushels of seed (16-inch spacing) were used. However, there was a very radical difference in the yields and returns from 22.66 bushels of seed (8-inch spacing) and 1000 pounds of fertilizer to the acre, from 22.66 bushels of seed and 1500 pounds of fertilizer, and from 15.11 bushels of seed and 2000 pounds of fertilizer to the acre, although the cost of these three combinations was approximately the same. The returns above the cost of materials for these three combinations were $79.00, $108.50, and $137.34 for each acre, respectively. It is quite apparent, therefore, that the choice is not always open between an investment in more seed or more fertilizer. The data indicate, in general, that in changing from wide spacing to the intermediate spacings, returns are more assured for increases in the quantity of seed used than in changing from the intermediate spacings to a very close spacing. At each of the three rates of application of fertilizer it is especially to

be noted that no increase in returns is obtained by reducing the spacing from 12 to 8 inches. Very substantial increases in returns were obtained, however, at all spacings for each increase in the rate of application of fertilizer. The general trend of the results would, therefore, indicate that under the conditions of this experiment fertilizers may more quickly than seed become the limiting factor in production and that increases in the rates of application of fertilizers may be made with more certainty of returns than increases in the quantity of seed used.

In most experiments which involve spacing of seed pieces the relation of the distance between pieces to the size of the tubers produced has been emphasized. The results and discussion so far presented in this paper have been based only on No. 1 potatoes. Data obtained in this experiment show that certain combinations do give a rather low percentage of No. 1 potatoes based on the size specifications of the U. S. standard grades, but that the rate of fertilizer application greatly affects percentage of potatoes which falls below the size specifications of U. S. No. 1's. With 2000 pounds of fertilizer to the acre at all spacings, approximately 75 per cent of the potatoes graded U. S. No. 1. With 1500 pounds the percentage of No. 1 potatoes was practically the same as with 2000 pounds for all spacings except for the 8-inch spacing which graded only 68.2 per cent No. 1's. With 1000 pounds of fertilizer to the acre the percentage of No. 1 potatoes at the 8-inch spacing was 62.5 per cent, and for the other spacings approximately 71 per cent. With only 1000 pounds of fertilizer the percentage of small potatoes was, therefore, larger for all spacings than it was at the two higher rates of fertilizer application, and the quantity of small potatoes was excessive at the 8-inch spacing.

It appears from a consideration of all combinations used in this experiment that the combination of 2000 pounds of fertilizer with a 12-inch spacing is the most desirable. With this combination the calculated value of an acre of potatoes above the cost of materials was considerably higher than for any other combination at all four assumed prices for seed and market potatoes except for the 2000-pound-per-acre-rate of fertilizer application with an 8-inch spacing. Even with an 8-inch spacing, returns from three of the price combinations were the same or smaller than with a 12-inch spacing, and the increased value of the potatoes produced with the other price combinations was scarcely large enough to justify the more intensive combination (table 2).

TABLE 1.—*Yield, cost for each acre, cost of a bushel, and returns from each acre from different rates of application of fertilizer and different spacings of seed pieces when prices for seed potatoes and market potatoes are approximately normal.*

Space between Pieces*	Seed on Each Acre	Yield No. 1 Potatoes On Each Acre			Cost of Materials for One Acre**			Cost of Materials for Each Bushel of Potatoes			Value of Each Acre Above Cost of Materials		
		Fertilizers per Acre***											
		1000 Pounds	1500 Pounds	2000 Pounds	1000 Pounds	1500 Pounds	2000 Pounds	1000 Pounds	1500 Pounds	2000 Pounds	1000 Pounds	1500 Pourds	2000 Pounds
Inches	Bu.	Bu.	Bu.	Bu.	Dollars	Dollars	Dollars	Cents	Cents	Cents	Dollars	Dollars	Dollars
20	9.06	109	130	140	28.60	36.10	43.60	26.23	27.76	31.14	80.40	93.90	96.40
16	11.33	123	141	162	32.00	39.50	47.00	26.02	28.01	29.01	91.00	101.50	115.0
12	15.11	133	165	190	37.66	45.16	52.66	28.31	27.36	27.71	95.34	119.84	137.34
8	22.66	128	165	201	49.00	56.50	64.00	38.28	34.24	31.84	79.00	108.50	137.00

*All seed pieces 1 ounce; rows spaced 36 inches apart.

**Calculations based on market potatoes at $1.00 for each bushel for No. 1's, on seed potatoes at $1.50 for each bushel, and on fertilizer at $30.00 per ton.

***A 6-10-6 (N-P-K) fertilizer was used.

TABLE 2.—*Value for each acre of potatoes above cost of seed and fertilizers for different rates of application of fertilizer and different spacings of seed piece when seed potatoes and market potatoes are normal and high in price.*

Spacing of Seed *	Seed on Each Acre	When Seed Cost $1.50 for Each Bushel and Potatoes Bring $1.00 a Bushel			When Seed Cost $1.50 for Each Bushel and Potatoes Bring $1.50 a Bushel			When Seed Cost $2.40 for Each Bushel and Potatoes Bring $1.00 a Bushel			When Seed Cost $2.40 for Each Bushel and Potatoes Bring $1.50 a Bushel		
		Rate of Application of Fertilizer per Acre**											
		1000 Pounds	1500 Pounds	2000 Pounds	1000 Pounds	1500 Pounds	2000 Pounds	1000 Pounds	1500 Pounds	2000 Pounds	1000 Pounds	1500 Pounds	2000 Pounds
	Bu.	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
20	9.06	80.40	93.90	96.40	134.90	158.90	166.40	72.25	85.74	88.24	126.74	150.74	158.24
16	11.33	91.00	101.50	115.00	152.50	172.00	196.00	80.80	91.30	104.80	142.30	161.80	185.80
12	15.11	95.34	119.84	137.34	161.84	202.34	232.34	81.76	106.26	123.76	148.26	188.76	218.76
8	22.66	79.00	108.50	137.00	143.00	191.00	237.50	58.60	88.10	116.60	122.60	170.60	217.10

*All seed pieces 1 ounce; rows spaced 36 inches apart.

**A 6-10-6 (N-P-K) fertilizer was used.

LITERATURE CITED

1. Aicher, L. C. 1920. Experiments in size of seed piece and other factors in the production of potatoes under irrigation in southern Idaho. Idaho Agr. Exp. Sta. Bul. 121.
2. Bushnell, John. 1930. Rate of planting potatoes with some reference to sprouting habit and size of plants. Ohio Agr. Exp. Sta. Bul. 462.
3. Emerson, R. A. 1907. Potato experiments. Nebr. Agr. Exp. Sta. Bul. 97.
4. Edmundson, W. C. 1935. Distance of planting rural New Yorker No. 2; and Triumph potatoes as affecting yield, hollow heart, growth cracks and second-growth tubers. U. S. D. A. Cir. 338.
5. Jensen, H. J., and Morris, O. M. 1931. Potato growing in the irrigated districts of Washington. Wash. Agr. Exp. Sta. Bul. 246.
6. Moore, H. C. 1927. Hollow heart of potatoes. Mich. Agr. Exp. Sta. Quart. Bul. 9.
7. Sprague, H. B., and Evaul, E. E. 1929. Effect of size of seed piece and rate of planting on yield of white potatoes. Jour. Am. Soc. Agron. 21: 513-23.
8. Stuart, William, et al. 1924. Size of potato sets. U. S. Dept. Bul. 1248.
9. Werner, H. O. 1919. Potato experiments. N. Dak. Agr. Exp. Sta. Bul. 129.
10. Wessels, P. H. 1934. Influence of level of fertility on the optimum spacing for potatoes. Am. Potato Jour. 11: 17-20.
11. Zavitz, C. A. 1916. Potatoes. Ont. Dept. of Agr. Bul. 239.

THE EFFECT OF HIGH STORAGE TEMPERATURE UPON FALL-GROWN SEED IRISH POTATOES

JULIAN C. MILLER, W. D. KIMBROUGH, AND J. G. RICHARD

Louisiana State University, Baton Rouge, Louisiana

About one-fourth of the spring Irish potatoes grown in Louisiana are produced from home-grown fall potatoes. The yields from these potatoes, barring exceptional years, are not nearly so large as those produced from northern certified seed. Fall seed is slow to germinate and the potatoes produced are late. The fall potatoes may be available on the farm and require no cash outlay. For this reason many small patches of potatoes may be planted by those unable to buy northern certified seed. Some larger growers who plant most of their crop with certified seed may desire part of the crop to be late and therefore plant that part to fall-grown seed. As fall seed is used and will continue to be employed to some extent, information should be obtained so that this seed may be used to best advantage.

Disregarding the question of disease which is important, the main fault with fall seed is that insufficient time passes between digging and planting for termination of the rest period. This explains the slow germination and ragged stand early in the season. The earlier fall-grown seed potatoes are harvested, the better they are for seed the next spring. This is shown in table 1.

TABLE 1.—*Effect of dormant period upon yield of Triumph Irish Potatoes. (2-year average)*

Source of Seed	Days between Harvesting and Planting	Yield in Bushels per Acre			
		U. S. 1	U. S. 2	Culls	Total
Louisiana fall-grown	100	118.0	15.6	4.2	137.8
Louisiana fall-grown	60	78.0	11.2	3.5	92.5
Louisiana fall-grown	30	65.4	10.7	4.2	80.3
Western dryland certified..	150	136.8	15.7	5.4	157.9

The data show that the yield varied directly with the length of time between harvesting and planting. This means that the sooner fall potatoes can be dug and the later the time for planting potatoes in the spring, the better will be the seed. As good results with fall seed cannot be expected in southern Louisiana, where they will probably be harvested later and planted earlier, as can be expected farther north in the state where they are dug earlier and planted later.

Fall potatoes cannot be planted too early in the summer, for then the temperature will be too high for the plant to make normal growth.

As the rest period is a very important factor connected with the value of fall potatoes for seed, anything that the growers can do simply and easily to shorten this period will be beneficial. High temperature has been known to shorten the rest period of Irish potatoes. Therefore fall potatoes were kept at temperatures ranging from 60 to 75° F. from harvest until planting, whereas other lots were kept in common storage where no artificial heat was used. They were planted and yields from both lots were compared with those from western dryland certified seed. These yields are given in table 2.

The data show that yields from the plots planted with fall potatoes stored at high temperatures, were higher than from those planted with seed from common storage. If fall potatoes can be stored at high temperatures, their value for seed will be greatly increased. The fall-grown high temperature seed in these tests did not give so high yields as the northern certified seed.

Although the use of fall-grown potatoes for seed in the spring is not generally recommended, if they are used they should be given as long a rest period as possible and kept at relatively high temperatures. Some growers maintain the high temperature by using small

TABLE 2.—*Yields of Irish potatoes from fall-grown and western certified seed. (2-year average)*

Source of Seed	YIELDS In Bushels per Acre					
	Grown at L. S. U.			Grown at Houma		
	U. S. I	U. S. 2	Culls	U. S. 1	U. S. 2	Culls
Fall—High Temperature	171.3	24.9	9.9	173.3	14.5	9.9
Fall—Common Storage..	127.7	16.5	9.4	109.8	13.7	3.3
Western Dryland Certified	224.7	32.9	9.4	216.4	21.7	6.1
	Grown at Alexandria			Average		
Fall—High Temperature	143.3	18.3	8.1	162.6	19.2	9.3
Fall—Common Storage..	86.3	18.8	8.1	107.9	16.3	6.9
Western Dryland Certified	229.4	21.4	9.0	223.5	28.7	8.2

oil heaters or lanterns in rooms that can be tightly closed. If fall-grown potatoes are to be used for seed the following spring, it is recommended that they be grown from the best certified seed. A grower may get enough certified seed for increase or may buy No. 2 potatoes from a neighbor for fall planting.

SECTIONAL NOTES

COLORADO

The San Juan Basin potato show will be held at Durango during November; the one in Weld County in January; and the State seed show which has been transferred from Colorado Springs to Denver, will be held in connection with the National Western Stock show, from the 15th to the 22d of January. The Montrose County show will be held in February or March.

Growers are enthusiastic about the new marketing agreement, and are organizing to propose a law to the next session of the legislature permanently prohibiting the sale of culls.

The certified seed potato inspections have been completed. The acreage and number of bushels by varieties follow:

Varieties	Acreage	Bushels
Katahdin	49	13,980
Perfect Peachblow	565	169,055
Red McClure	245	70,375
Bliss Triumph	624	74,300
Irish Cobbler	215	38,205
Brown Beauty	97	32,200
Russet Burbank	31	8,750
Rural New Yorker	18	2,800
Chippewa	12	2,200
Russet Rural	5	700
	1,861	412,565

(Nov. 13)—C. H. METZGER.

INDIANA

The potato situation in Indiana has remained unchanged from the last report, inasmuch as the demand is very slow and the supply of good potatoes is plentiful. One hundred pound sacks are retailing at $1.10 to $1.40, depending somewhat upon the grade and the condition, and some of the best potatoes received in the state to the present time have been from Indiana growers. These potatoes were of the Katahdin variety and, although grown upon muck, were clean, bright, and well-brushed. Practically all the potato harvesting has been completed because of the very favorable fall weather. Our yields among the commercial growers range from approximately 160 to 651 bushels of No. 1 grade potatoes to the acre, with the latter being the highest yield for this year.

Potato growers are awaiting the decision of the Government regarding the Potato Control Act before making plans for next year's crop. (Nov. 9)—W. B. Ward.

MAINE

The reduction in total supplies of potatoes indicated by the last report is welcome to all our growers, though we do not anticipate marked improvement in prices as a result. It is in the right direc-

tion, however, and we are hoping that the December report will be of further assistance.

Prices are remaining fairly steady both on seed and on table stock. It is disturbing, however, to see carlot shipments continue to be as small as they have been during the last three weeks, as this undoubtedly reflects a heavy truck movement and not a decrease in consumption.

We are getting a splendid response in Maine from our advertising program. The stabilized condition and the improved price levels have resulted in a large measure from this promotion effort. It has been an ideal year to start this advertising, the low price level has permitted wide distribution and the splendid quality has merited repeat orders which combine to make a very satisfactory basis for the distribution of our crop. Retail interests of both the National Association of Retail Grocers and chain stores have shown splendid interest in assisting potato growers to move their crop. Never before have we had such splendid cooperation from the retail trade which has been made possible by quality advertising and our industry efforts at stabilization.

The weather conditions have been very favorable for farmers to complete their fall work. Plowing, picking rocks, etc., have been done more completely than usual. Some farm improvement work, has also been conducted, that is, as much as finances permit.

Further conferences have been held on a Marketing Agreement and a diversion program. Assurances have been received that the diversion program for starch purposes will be started immediately with the further understanding that growers are to approve the originally proposed, but once rejected, marketing agreement. If they fail to approve it the second time, the diversion program is to stop. It is hoped that this will result in the assuming of equal responsibilities in the national plan for the elimination of inferior grades on the part of our growers. (Nov. 13).—Frank W. Hussey.

Nebraska

At this time, practically all of the certified potatoes in Nebraska have been given a bin inspection. Because of adverse growing conditions, it was anticipated that a great deal of Fusarium Wilt infection would be found in the tubers. After making bin inspections, the reverse is found to be the case, and fewer rejections, caused by this disease, have been experienced this year than is normally the case. A higher percentage than usual, of scab infection, has been found.

A few shipments of certified Bliss Triumphs have been made into California. The majority of shipments for seed purposes will not begin until after the first of the year. That movement will be shipped largely to the southern states.

Practically 95 per cent of the shipments from Nebraska will be of the Bliss Triumph variety, both certified and commercial. The balance will be largely those of the Cobbler variety, with a few Warbas, Early Ohios and Katahdin.

At the present time the market for table stock is slow, prices having receded somewhat within the past two weeks. Growers are receiving 60 cents per cwt. f. o. b. for U. S. Commercial Grade, and 70 cents per cwt. for U. S. No. 1. This movement consists largely of table stock potatoes going into immediate consumption. Nearly all the Nebraska crop will be shipped after the beginning of the year, unless there is an unusual spurt in market conditions before that time. Generally speaking, about one-half of the total crop finds its way into seed channels.

There has been an active sale of certified potatoes at $1.25 per cwt. f. o. b. for the January shipment. There has been a larger sale of futures this year that is usually the case. A feeling on the receiving end that the Government marketing program will improve the price seems to be general and the people are trying to protect themselves against an advance.

The Potato Control Committee, including the states of Wyoming, Colorado, and Nebraska, has recommended that no potatoes poorer than U. S. Commercial grade, go into inter-state movement. They have also recommended that the Government purchase potatoes of poorer quality, and divert them into channels other than human consumption. The first recommendation is just being put into effect, and the latter will be, as soon as it has been approved by the proper authorities.

It is rather early to make any predictions regarding the intentions to plant for 1938. There will probably be some increase in the acreage planted, because the acreage for 1937 was considerably lower than the average for the state. This was caused by the severe drought conditions in 1936, and the extremely high-priced seed in the spring of 1937. (Nov. 10).—Marx Koehnke.

New York

The November first potato estimate for New York places the 1937 crop at 28,625,000 bushels. This is a decrease of approximately 700,000 bushels below the October estimate or 2,200,000

bushels above the 1936 harvested crop. Both the crop yield and the quality are exceptionally spotty this year. Growers generally feel that the government estimates are too high. Wet weather at planting time and during August resulted in a shallow root and tuber growth in many fields. Late planting encouraged many growers to delay harvest in the hope that the plants might mature and the yield increase. The results were considerable second growth, freezing injury and sunburn in the harvested crop. The months of September and October were sub-normally dry in much of western New York. The yields in this area are therefore very disappointing. At present the shipping point price to growers ranges from forty-five cents to fifty cents a bushel.

Nearly all our yield tests of varieties and seedlings have been harvested and the results reported. Again Chippewa, Katahdin and Houma have performed creditably. The acreage of all three of these will undoubtedly be increased next year. Among the unnamed seedlings which show much promise in New York are 45075, 46000, 46110, 44488, and 44866.

Reports concerning the cooking quality and the handling quality of Chippewa and Katahdin are conflicting. One Long Island grower states that Chippewa is very subject to bruising and rot. The writer recently spent ten days on the Cleveland market where several carlot shipments of Chippewa and Katahdin from Maine were observed. It seemed obvious there that neither of these varieties bruised so readily as Green Mountains from the same source and subject to the same handling. Although the Katahdin plainly showed surface discoloration from handling, the tubers did not actually bruise so badly as Green Mountains. Both wholesalers and retailers generally spoke very highly of the consumer preference for these new varieties. (Nov. 16).—E. V. Hardenburg.

North Dakota

The acreage of seed potatoes approved for certification this year is approximately the same as it was last year. However, because of the more favorable weather conditions, an aggregate increase of about 25 per cent is expected above last year.

The total acreage of approved certified seed potatoes is 9,759. Of this total, there were 4,380 acres of Bliss Triumphs; 4,545 acres of Cobblers; 717 acres of Early Ohios; and 117 acres of miscellaneous varieties.

Concerning potatoes in general, including all table stock, this state

will have a normal, or slightly above normal, amount to market. This fall the carlot movement from North Dakota has been heavier than it has ever been. About one-half of our entire production which will be available for export has been shipped. Nearly all the shipments from this state during 1937 have been inspected and covered by a Federal-State certificate. In previous years, less than one-half of the shipments were inspected.

North Dakota is one of the states in which the federal marketing agreement order is effective. Under this order all potatoes will be inspected. Certified potatoes, of course, are always inspected each year, under state regulations.

Under the federal marketing order very little has been done, as yet, in this state. Although a majority of the people who voted on the proposal indicated their approval, there was a very light vote cast in all of the states. We are, therefore, not in a position to know what the popular sentiment or support for the order will be. It was not put into effect until after the peak of our fall movement. (Nov. 10).—E. M. GILLIG.

VERMONT

The harvest of the 1937 crop shows a yield which is generally lighter than usual. The plants made very rapid growth during July and the first part of August, but many fields failed to stand up against the intense heat during the latter part of the season. In the "400 Bushel Club", sponsored by the Certified Seed Growers' Association, only two growers, Gebbie & Hill and J. I. Wilson, both of Greensboro, qualified, the former with 492.7 and the latter with 416.2 bushels. Last year from the same number of growers, fourteen qualified. The quality of stock has appeared to be very good, with extremely little late blight. Low temperatures in mid-October resulted in frost injury in few fields.

Vermont growers who voted on the voluntary control proposal were strongly in favor of it,—126 voted affirmatively and 12 negatively. Although these numbers do not loom large against the 21,000 farms reporting potatoes in the 1935 census, it is a fact that not a great many more than the total number of voters are in the potato business from a strictly commercial standpoint.

A tentative plan for supplying the Vermont stores of three big chain systems, with locally grown potatoes, has been set up with the Vermont Maple cooperative Inc., of Essex Junction acting as a central agency for a pool. The only question that appears to be bother-

some at present is that of an adequate supply of stock for delivery to the stores from growers conveniently located about the state. As indicated in the preceding note, the number of potato growers having two or more acres is comparatively small and a grower must have grown at least two acres to make it practicable to participate in the pool. If the deal goes through, the top Boston price quotation on each Monday will be the price paid to the growers for delivery to stores assigned them. (Nov. 12).—Harold L. Bailey.

Virginia

The potato and vegetable growers in Eastern Virginia have organized county units of the American Farm Bureau Federation, with a view of establishing commodity committees under these Bureaus which will function with similar or other type potato and vegetable growers' organizations throughout the United States.

This is the Virginia potato and vegetable growers' response to the proposal of the Department of Agriculture that these groups should organize and appoint state representatives, who will confer nationally to further the interests of these groups in legislative and economic matters.

The general feeling of the Virginia potato growers is toward crop control by national legislation, in view of the low prices that have prevailed, as a whole, since 1928. They desire to investigate and determine the causes of over-production and low returns to farmers, and to set up whatever means that are possible to improve the earning power of the potato and vegetable growers, without any improper hardship on the consumer.

The acreage will, unquestionably, be reduced somewhat next season through the pressure of low prices and low income this year. However, the growers feel that, allowing conditions to remain as they have been, provides no assurance of improvement in the economic status of the potato growers.

Other matters are being held in abeyance at this time. (Nov. 13).—G. S. Ralston.

Wisconsin

A series of "Potato Institutes" or Special Potato Days have been scheduled in Wisconsin during the months of November and the early part of December. These field projects are devoted mainly to seed potato improvement and dissemination of seed potato stocks. Nearly the entire output of certified seed of the Rural group will be disseminated inside the border of the state this year.

Although certain crops eligible for certification moved into the table stock market at an early date, still about 130 to 150 cars that are eligible for certification probably remain in storage.

Crop estimating proved very baffling in Wisconsin in 1937. The production of early varieties, like the Cobbler, was fairly normal. The late main crop proved the most disappointing. Even areas that appeared to show good vine growth did not prove to give good yields. Many believe the estimate of 18½ million is still high.

More than 1200 acres were irrigated in Wisconsin in 1937. Favorable increases in yields on watered areas during the past two dry seasons have aroused increased interest in these operations. (Nov. 13).—J. G. MILWARD.

CANADA

According to the first estimate, released on the 8th of October by the Dominion Bureau of Statistics, the production of potatoes in Canada in 1937 will amount to 41,799,000 cwt. from 532,500 acres, as compared with 39,034,000 cwt. from 496,400 acres in 1936,—yields on each acre being 78 cwt. and 79 cwt. respectively. By provinces the total production in cwt. is estimated as follows, with the figures for 1936 within parentheses: Prince Edward Island 3,222,000 (3,941,000); Nova Scotia 1,870,000 (1,957,000); New Brunswick 5,823,000 (5,683,000); Quebec 12,315,000 (12,336,000); Ontario 9,789,000 (8,700,000); Manitoba 2,705,000 (1,006,000); Saskatchewan 1,351,000 (1,635,000); Alberta 2,418,000 (1,816,000); and British Columbia 2,306,000 (1,960,000).

Preliminary figures covering acreage which passed field inspection in Prince Edward Island in 1937, compared with final figures for 1936, are as follows:

	1936	1937
Irish Cobbler	7,057	8,321
Green Mountain	2,624¼	4,372
Bliss Triumph	148½	413
Others	13¼	35
Total	9,843	13,141

The figures covering certified seed acreage for the remaining portion of Canada are incomplete at this date but will appear in the next issue of the Journal. (Oct. 12).—JOHN TUCKER.

CUBA

Planting of our early crop of potatoes is nearly finished now. Several projects have been started at the main government station at Santiago de las Vegas, and in seven different localities, with the cooperation of the growers. Among the projects, fertilizers, depth and distance, and size of seed piece tests are included. A breeding project which seems to be the first one to be started in the tropics has been made possible by the kindly cooperation of Dr. Julian C. Miller, who sent more than two hundred and fifty seedlings from the Louisiana Experiment Station, and to Dr. K. O. Müller who is sending several hundred crosses resistant to "late blight" from the Biologische Reichsanstalt für Landwirtschaft. Another interesting project is the one being conducted with the cooperation of our Chemical Division to find a chemical compound which, when acting to break the rest period, would stain the skin without any detrimental effect to the germination. This would distinguish seed potatoes which enter Cuba duty-free from those brought in for human consumption. (Nov. 6).—M. A. TAMARGO.

REVIEW OF RECENT LITERATURE

Influence of storage temperature and humidity on seed value of potatoes. ORA SMITH. (*Cornell Univ. Agr. Exp. Sta. Bul.* 663. (1937). pp. 1-31).

During the four-year period 1932 to 1935, field studies were conducted to determine some of the effects of various methods of storing seed potatoes on subsequent plant growth and yield. The Irish Cobbler and Smooth Rural varieties were grown in these experiments. Comparisons were made between storage in five commercial potato-storage houses and at various locations within each storage. Seed was also stored in constant-temperature cold-storage rooms during the entire storage period at both high and low humidities. Shifts in temperature were also made for other treatments from five to eight weeks before planting.

Low humidity in storage resulted in the lowest number of sprouts to each seed piece but in the longest individual sprouts. The largest number of sprouts appeared on tubers stored at 40° F. and later shifted to 50°, but they were rather short.

The final stand of plants is usually lower from seed that has been stored at 32° than from seed stored at higher temperatures.

The differences in rate of emergence of plants are not so marked as would be expected from the differences in average storage-season temperatures and humidities between the several commercial storages. This is owing primarily to the fact that unless the tubers are removed from storage and planted early, the temperature in all of the storages for the last month or two is above the sprouting temperature.

Plants from tubers stored in the constant-temperature cold-storage rooms appear above ground in the following order: 50°, 40°, 35°, and 32°.

The largest number of stems for each seed piece is produced by tubers which have been stored at the higher temperatures.

The largest total number of tubers from each plant, as well as the largest number of U. S. No. 1 size tubers, are formed from tubers which have been stored at the higher temperatures.

The Irish Cobbler and Smooth Rural varieties respond differently in yields of tubers to the same storage conditions. The largest yields of Irish Cobbler were usually obtained from storage at 40° for all or a portion of the storage period, whereas highest yields of Smooth Rural resulted from storage at 50° for a portion or all of the storage period.

Apparently sprout growth with the Irish Cobbler becomes too extensive for maximum yields when stored at 50°, whereas sprout growth with the Smooth Rural is slower and reaches the optimum at 50° or slightly lower.

Those storage treatments which produce plants above ground first do not always result in highest yields of tubers.

In localities where early planting usually results in highest yields it would be desirable to store seed at the higher temperatures so that sprout growth at planting time would be as large as possible without having them damaged or broken off in the cutting and planting operations. Where later plantings usually result in highest yields, any treatment which suppresses sprout growth, such as low temperature, will result in increased yields unless planting is delayed too long.

Plants from tubers which are stored at any of the treatments with an initial temperature of 50° mature approximately seven to ten days earlier than do those stored at 40°.—(Author).

American Potato Journal

PUBLISHED BY

THE POTATO ASSOCIATION OF AMERICA

SOMERVILLE, N. J. NEW BRUNSWICK, N. J.

WHAT OF 1938?

Based upon information released October 1 by the Bureau of Agricultural Economics, on the intentions to plant of the potato growers in the nineteen early and intermediate states, the prospects for next year are not particularly bright. According to this report, these growers intend to plant approximately 311,300 acres, a reduction of only 9.5 per cent of the acreage harvested this past season, and only slightly less than the average for the years 1928-'32.

We all know what happened this year as a result of the large crop. The growers along the Atlantic Seaboard received prices which were far too low to pay the cost of production despite the purchase of potatoes for relief purposes by the Federal Government. Without this assistance it is difficult to predict what the price might have been.

The proposed potato control plan promises to be beneficial to the industry, but if the acreage is not decreased more than the intentions to plant indicate, there is a chance that with normal yields the growers will face another disastrous season. It is doubtful if any plan can be devised which will enable the potato growers to move an exceptionally large crop at a profit since prices are not influenced so much by the quantity marketed as by the total supply available.

No Government control program can be successful without the full cooperation of the growers. If the grower who adopts the proposed plan eliminates his poorest acres and uses better cultural practices on the remainder, it is very possible that he will increase, rather than decrease, his total production. It behooves the individual grower to give some thought to controlling production and marketing a better product. With a medium crop of excellent quality, both the grower and consumer will derive real benefit. With a large crop, low prices will prevail regardless of the control plan in operation.